

DISTRIBUTION OF PONDEROSA PINE (*PINUS PONDEROSA*) FEEDING SAWFLIES (HYMENOPTERA: DIPRIONIDAE) IN THE UNITED STATES AND CANADA¹

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ABSTRACT: Six species of diprionid sawflies are known to feed on ponderosa pine, *Pinus ponderosa*, in western United States. Collection records were compiled from 29 insect collections throughout the United States and Canada. Based on these records, distributions of the species on ponderosa pine are reported.

Six species of diprionid sawflies (Diprionidae), five in the genus *Neodiprion*, feed on ponderosa pine, *Pinus ponderosa* Dougl. ex Laws., the most widely distributed pine in North America (Fowells 1965). Diprionid sawflies are major economic pests of natural and plantation forests in the eastern United States (Wilson 1977.) As forest management intensifies in the West, sawflies are increasingly important economic pests (Dahlsten 1961, 1966). This research was undertaken to determine the distribution of diprionids feeding on ponderosa pine. Records have never been compiled for these insects. Keys for identification of North American genera are provided by Ross (1955) and Smith (1974).

METHODS

Twenty-nine federal and state research stations, museums and universities provided 97 collection records for sawflies found feeding on ponderosa pine. These localities were plotted on a map with the distribution of ponderosa pine (Fig. 1). The distribution of ponderosa pine was taken from Fowells, 1965. The distribution of each species of sawfly was then determined by considering both the collection records and the distribution of its host (Fig. 2)

RESULTS

Locality data for each species are as follows:

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Zadiprion townsendi (Cockerell)

ARIZONA: Flagstaff, 28 Jun 1916; Santa Rita Mts., Jul 1924; North Rim, Grand Canyon, 7 Dec 1964; Mt. Lemmon, Sta. Catalina Mts., 3 Aug 1967. COLORADO: Jefferson Co., Evergreen, 26 Aug 1937; Teller Co., Woodland Park, 2 Jun 1938; Boulder Co., Boulder, 2 Mar 1963; Chambers Lake, Roosevelt N.F., 9200 ft., 2 Aug 1968; Larimer Co., Rist Canyon, Mar 1979; El Paso Co., Black Forest. NEBRASKA: Dawes Co., Crawford 12-28 Jul 1910; Dawes Co., Pine Ridge, Jul 1910; Sioux Co., War Bonnet Canyon; Sioux Co., Hat Creek; Lancaster Co., Lincoln 1 May 1914. NEW MEXICO: Bernalillo Co., Rio Arriba Co., Vallecitos, 30 June 1924; Socorro Co., Magdalena, 13 Jan 1961; Tijeras, 19 Dec 1969; Bernalillo Co., Sandia Park, 19 Dec 1969; San Jaun Co., 8.7 mi. N. Navajo, 30 Jun 1972. SOUTH DAKOTA: Custer Co., Custer State Park, nr Custer, 1911. UTAH: San Juan Co., Blanding, Chippean Ridge 2 Nov 1972.

Neodiprion autumnalis (Smith)

ARIZONA: Yavapai Co., Camp Verde, 18 May 1981; Coconino Co., Flagstaff, 26 May 1981; Apache Co., Springerville, 13 Aug 1981. CALIFORNIA: Butte Co., Jarbae Pass, 12 May 1949; Shasta Co., Mt. Shasta, 14 Aug 1957; Humboldt Co., Orleans, 8 May 1961; Trinity Co., Ruth, Oct 1976. COLORADO: Teller Co., Woodland Park, 5 Oct 1914; El Paso Co., Husted 12 Oct 1914. IDAHO: Kootenai Co., Coeur d'Alene, 18 Sep 1922; Idaho Co., Grangeville, 19 Jun 1971. MONTANA: Sanders Co., Camas 28 Aug 1913; Lake Co., Bitterroot N.F., Ravalli, 11 Oct 1959; Phillips Co., Landusky, 24 Sept 1959. NEBRASKA: Cherry Co., Valentine, 23 Jul 1971; Dawes Co., Nebraska N.F., Chadron, 20 Jun 1973. NEW MEXICO: Cibola Co., Grants, Jun 1957. OREGON: Allison R.S., reared 1943; Klamath Co., Diamond Lake, 25 Sep 1963. SOUTH DAKOTA: Custer Co., Pringle, Sep 1935; Harding Co., Camp Crook, 1 Sep 1971; Perkins Co., Lemmon, 6 Jun 1972; Todd Co., Olsenville, 23 Jun 1972; Todd Co., Rosebud, 14 Jun 1973. WASHINGTON: Spokane Co., Spokane, 26 Sept 1960.

Neodiprion fulviceps (Cresson)

ARIZONA: Coconio Co., Flagstaff nr I-40, 21 Jul 1982. NEVADA.

Neodiprion gillettei (Rohwer)

ARIZONA: Yavapai Co., Prescott, 11 Jun 1928; Yavapai Co., Oak Creek Canyon, 7 Oct 1951; Chiricahua Mts., 21 Aug 1961; Sitgreaves N.F., Chevelon Rd., 7 Jul 1969; Oak Creek, vicinity of Sedona, 1 Oct 1970; Kaibab N.F., 22 Sep 1974; Apache Co., Springerville 27 May 1987. COLORADO: Grand Co., Granby, 9 Nov 1961; Larimer Co., Rist Canyon 21 Jul 1986.

Neodiprion mundus (Rohwer)

UNITED STATES. IDAHO: Valley Co., Cascade, 9 Jul 1961; Idaho Co., White Bird, 21 Oct 1961. OREGON: Corvallis, 13 May 1951; Benton Co., Corvallis 3 Jun 1944. CANADA. Kelowna, B.C.

Neodiprion ventralis (Ross)

ARIZONA: Coconino Co., Flagstaff, 30 Jun 1982. COLORADO: Phillips Co., Holyoke; Jefferson Co., Plainview, Oct 1935. NEBRASKA: Lancaster Co., Lincoln, Oct 1977.

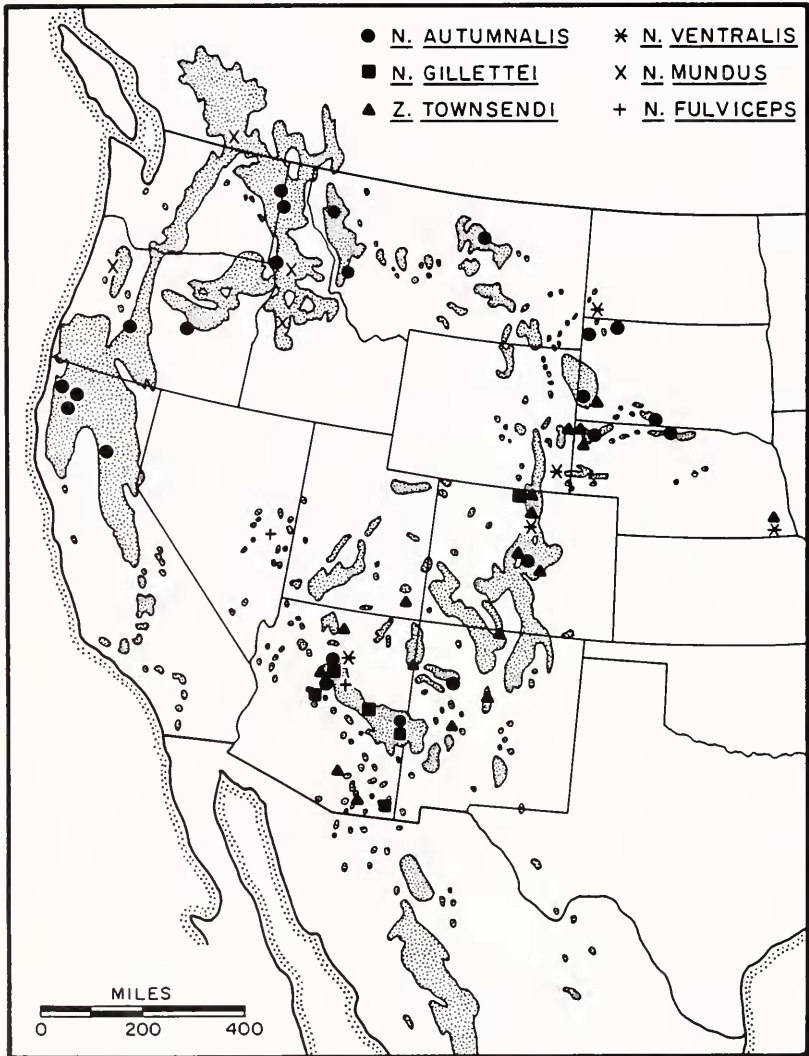


Figure 1. Distribution of ponderosa pine feeding sawflies from collection records. The distribution of ponderosa pine is indicated by stippled areas.

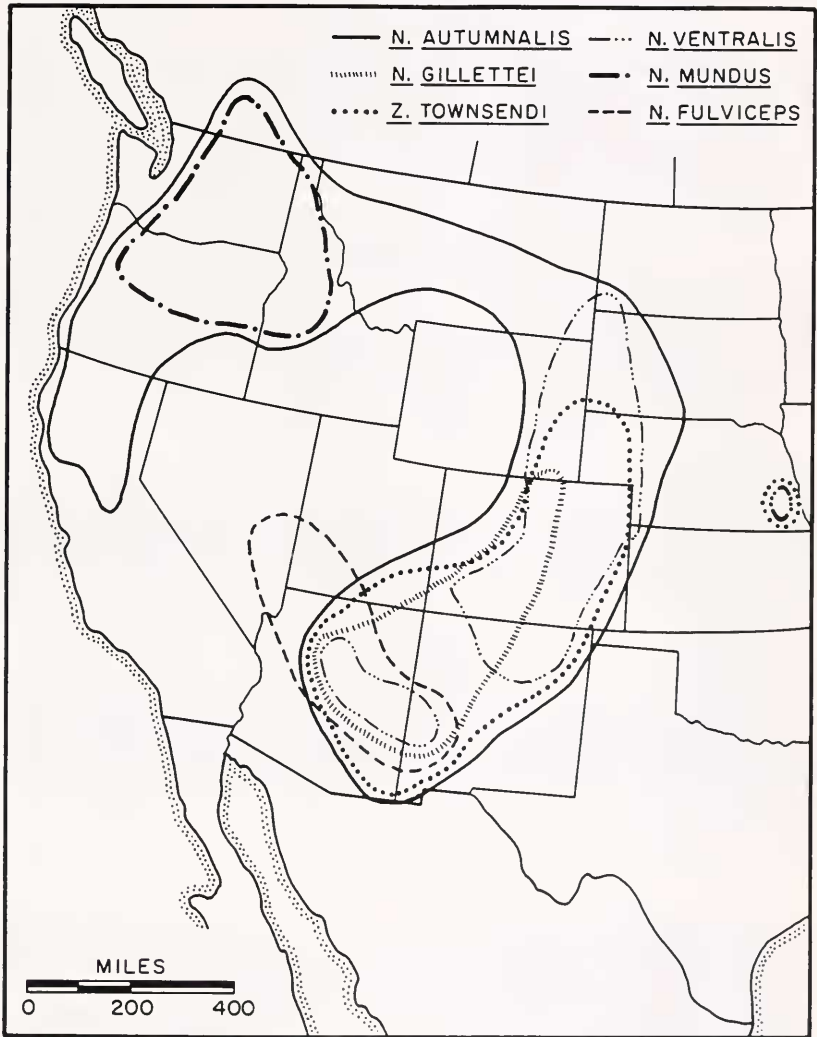


Figure 2. Hypothesised distribution of ponderosa pine feeding sawflies extrapolated from collection records and host distribution.

NORTH DAKOTA: Slope Co., Burning Coal Vein Area, 18 Jul 1973; Slope Co., 6 Jun 1974.
WYOMING: Platte Co., Glendo, 25 Oct 1961.

TAXONOMIC NOTES

The *Neodiprion fulviceps* complex was defined by Ross (1955). The complex was then separated into two species, *N. autumnalis* and *N. fulviceps* (Smith and Wagner 1986). *N. autumnalis* overwinters as eggs, whereas *N. fulviceps* overwinters as cocoons (Wagner *et. al.* 1986).

Many of the specimens previously identified as *Neodiprion fulviceps* complex, are actually *N. autumnalis* (Smith and Wagner 1986). Sawflies that were incorrectly identified as *Neodiprion edwardsii* and *Neodiprion demoides* by B.D. Burks, have been identified as *N. autumnalis* (Smith, personal communication). The following records are from specimens identified as *N. fulviceps*, but need to be reexamined for correct identity. Many may be *N. autumnalis* especially those collected late in the season, if the dates refer to adult emergence or collection records.

Neodiprion fulviceps (complex)

UNITED STATES. ARIZONA: Santa Rita Mts., 26 Sept 1925. CALIFORNIA: Siskiyou Co., Dorris, 20 Jun 1912; Mendocino Co., Ft. Bragg, 8 May 1936; Mendocino Co., Pygmy Forest, 4 mi. East Mendocino City, 21 May 1938; Plumas Co., West of Milford, 6000 ft., 8 Jul 1942; Mendocino Co., Mendocino, 1 Oct 1957. COLORADO: Jefferson Co., Plainview, 1 Jul 1937; Larimer Co., Ft. Collins, Jul 1964 as larvae, adults Sep 1964. MONTANA: Rosebud Co., Forsyth, 22; Jul 1922; Rosebud Co., Lee, 24 Jul 1922 (as larvae), adults emerged Sep 13-22 1922; Phillips Co., Little Rockies, Zortman, Sep 1960; Ravalli Co., Stevensville, 15 Jun 1973. NEBRASKA: Thomas Co., Halsey, 8 Oct 1936. NEVADA: Clark Co., Charleston Mts., Kyle Canyon, 7500 ft. OREGON: Benton Co., Peoria, 21 Apr 1940. UTAH: Garfield Co., Panguitch, Utah State University Farm, 17 Jul 1970; Millard Co., Kanosh, East Side of Clear Creek, 5 Aug 1970; Cache Co., Cove Fort, Clear Creek, 15 Oct 1970. CANADA. Cascade, B.C.; Falkland, B.C.; Fountain Creek, B.C.; Kelowna, B.C.; Okanagan Mission, B.C.; Osoyoss, B.C.; Pritchard, B.C.; Rock Creek, B.C.; Winfield, B.C.

DISCUSSION

Neodiprion autumnalis is the most widely distributed species reaching from the Southwest, north through the east side of the Rockies, across Montana to the Northwest and south to northern California. *Zadiprion townsendi* is found in the Southwest and as far north as the southwest corner of South Dakota. *N. gillettei* is located in the Southwest and as far north as northern Colorado. *N. ventralis* has been collected in northern Arizona, northern Colorado, southeastern Wyoming, and the southwest corner of North Dakota. *N. fulviceps* occurs in the Southwest and *N. mundus* in the Northwest (Fig. 2).

Five of the six species of sawflies that feed on ponderosa pine occur near Flagstaff, Arizona. We have observed some interesting features of the food resource allocation for four of these sympatric species. *N. gilletti* prefers small trees less than three feet tall or branches of older trees that touch the ground. *N. autumnalis* and *N. ventralis* generally occur on medium pole sized trees, while *N. fulviceps* typically feeds on older more mature trees. This type of stratification along with differing life cycles allows these sympatric sawflies to feed on the same species of pine without competing.

VOUCHER SPECIMENS

Depositories for voucher specimens are as follows: National Museum of Natural History, Washington, DC; Arizona State University, Tempe; Biosystematics Research Centre, Ottawa, Ontario; Bureau of Plant Industry, Lincoln, NE; California Academy of Sciences, San Francisco; California Department of Food and Agriculture, Sacramento; Colorado State University, Ft. Collins; Forest Service, Albuquerque, NM; Forest Service, Berkeley, CA; Forest Service, Ft. Collins, CO; Forest Service, Missoula, MT; Forest Service, Ogden, UT; Forest Service, Portland, OR; Forest Service, Washington, DC; Forestry and Range Sciences Laboratory, LaGrande, OR; Forestry Sciences Laboratory, Lincoln, NE; Montana State University, Bozeman, MT; Natural History Survey, Champaign, IL; Oregon Department of Agriculture, Salem; Oregon State University, Corvallis; Pacific Forestry Centre, Victoria, BC; University of Arizona, Tucson; University of California, Berkeley; University of Nebraska, Lincoln; University of Wyoming, Larmie.

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but the photographs survive being printed on matt-textured, cream-colored paper only because the originals were undoubtedly very sharp.

The nearly 500 pages of text can probably be said to sum up all that is currently known of scorpion biology, but may not be entirely up to date; the references and wording in some chapters suggest strongly that they were completed several years ago, perhaps as early as 1983. On the other hand, the bibliography contains numbers of references from 1987, and a handful from 1988.

As a systematist, I was particularly interested in the chapter on systematics and phylogeny, and found it a gem. It includes keys to all the known genera of scorpions, and diagnoses and other notes for each family. The section on fossil history relies almost entirely (and understandably) on the posthumous monograph of Kjellsevig-Waering, which now is seen as containing some serious errors and misinterpretations (for example, the "gills" of the Devonian *Tiphoscorpio* are in reality parts of an extinct myriapod, and the "carapace" of the same animal has no features of a scorpion). The life history and ecology chapters likewise are excellent, and the one on venoms morbidly fascinating.

The subject of fluorescence arises again in a chapter on field and laboratory methods, where it is remarked that 500 to 1000 scorpions can easily be captured in a single night using UV light. Sisson, Polis, and Watt warn, however, that while scorpions fluoresce, rattlesnakes do not. The scorpionologist must exercise caution!

In summary, this is truly a landmark book: the first real synthesis of the biology of a group of important and exciting organisms. It now becomes the standard reference on scorpions, and will remain so for many years.

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